PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

Application No.:	10/716,512	**Examiner:**	Kathleen MCNELIS
Filing Date:	November 20, 2003	**Art Unit:**	1742
First Inventor:	Koichiro INOUE	**Customer No.:**	23364
Attorney No.:	INOU3001/JEK/JJC	**Confirm. No.:**	5617
For:	MICROALLOYED STEEL EASY TO SEPARATE BY FRACTURE SPLITTING AT LOW TEMPERATURE AND FITTING MEMBER PRODUCED THROUGH SEPARATION BY FRACTURE SPLITTING AT LOW TEMPERATURE		

APPEAL BRIEF

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

INTRODUCTORY COMMENTS

This is an appeal brief filed pursuant to the applicants' appeal to the Board of Patent Appeals and Interferences from the final rejection of claims 1-7 in the above-identified application.

I. REAL PARTY OF INTEREST

The real parties of interest are the assignees of record: Daido Tokushuko Kabushiki Kaisha (JAPAN) and Honda Motor Co., Ltd. (JAPAN).

II. RELATED APPEALS AND INTERFERENCES

There are no other appeals or interferences which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

III. STATUS OF CLAIMS

A. Status of Claims in Proceeding

Claims 1-7 are currently pending in the pending application.

B. Identification of Appealed Claims

Claims 1 and 4 are independent claims.

Claims 2 and 3 depend from independent claim 1, and their patentability is based on their dependency from claim 1 and their individually recited features.

Claim 5-7 depend from independent claim 4, and their patentability is based on its dependency from claim 4 and its individually recited features.

A copy of all of the pending claims is provided in section IX.

IV. STATUS OF AMENDMENTS

There are no pending amendments of the claims and the last entered amendment was filed on October 17, 2005.

V. SUMMARY OF CLAIMED SUBJECT MATTER

At the onset of this section, it should be made known that the pending microalloyed steel of independent claim 1 is described in the specification without reference to drawings.

The fitting member (1) according to independent claim 4 has the same composition as the microalloyed steel according to claim 1.

A. Claim 1

Claim 1 describes a microalloyed steel separable by fracture splitting at low temperatures (page 5, lines 9-11). The steel comprises from 0.15 to 0.35 wt% carbon, from 0.5 to 2.0 wt% silicon, from 0.5 to 1.5 wt% manganese, from 0.03 to 0.15 wt% phosphorus, from 0.01 to 0.15 wt% sulfur, from 0.01 to 0.5 wt% copper, from 0.01 to 0.5 wt% nickel, from 0.01 to 1.0 wt% chromium, from 0.001 to 0.01 wt% soluble aluminium, from 0.005 to 0.035 wt% nitrogen, from 0.0001 to 0.01 wt% calcium, and from 0.001 to 0.01 wt% oxygen (page 5, lines 11-20). The remainder of the composition comprises iron and inevitable impurities, and which satisfies the following relationships 1 and 2:

Relationship 1,

$0.6 \leq Ceq \leq 0.85$,

wherein $Ceq = C+0.07xSi+0.16xMn+0.61xP+0.19xCu+0.17xNi+0.2xCr$;

Relationship 2,

$0 \leq T_{Tr} \leq 1.5$,

wherein $T_{Tr} = (C+0.8xSi+5xP)-0.5x(Mn+Cr+Cu+Ni)$ (page 5, line 21 – page 6, line 2).

The composition of the microalloyed steel lacks vanadium (page 7, lines 11-14).

B. Claim 4

Claim 4 describes a fitting member (1) (Fig. 1) separable by fracture splitting at low temperatures (page 5, lines 9-11). The steel comprises from 0.15 to 0.35 wt% carbon, from 0.5 to 2.0 wt% silicon, from 0.5 to 1.5 wt% manganese, from 0.03 to 0.15 wt% phosphorus, from 0.01 to 0.15 wt% sulfur, from 0.01 to 0.5 wt% copper, from 0.01 to 0.5 wt% nickel, from 0.01 to 1.0 wt% chromium, from 0.001 to 0.01 wt% soluble aluminium, from 0.005 to 0.035 wt% nitrogen, from 0.0001 to 0.01 wt% calcium, and from 0.001 to 0.01 wt% oxygen (page 5, lines 11-20). The remainder of the composition comprises iron and inevitable impurities, and which satisfies the following relationships 1 and 2:

Relationship 1,

$0.6 \le Ceq \le 0.85$,

wherein $Ceq = C+0.07xSi+0.16xMn+0.61xP+0.19xCu+0.17xNi+0.2xCr$;

Relationship 2,

$0 \le T_{Tr} \le 1.5$,

wherein $T_{Tr} = (C+0.8xSi+5xP)-0.5x(Mn+Cr+Cu+Ni)$ (page 5, line 21 – page 6, line 2).

The composition of the fitting member (1) lacks vanadium (page 7, lines 11-14).

VI. <u>GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL</u>

Claims 1 and 4 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. patent 5,769,970 (*Robelet*) in view of "Embrittlement of Iron" (*Vander Voort*) and Japanese patent 09-111412 (*Mitsuo*).

VII. ARGUMENT

As will be elucidated below, it is submitted that the basis for the final rejection of claims 1 and 4 does not amount to a *prima facie* case of obviousness against the microalloyed steel in the rejected claims. Therefore reversal of the rejection of claims 1 and 4 is respectfully requested.

A. Claim Rejections

Claims 1 and 4 were finally rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. patent 5,769,970 (*Robelet*) in view of "Embrittlement of Iron" (*Vander Voort*) and Japanese patent 09-111412 (*Mitsuo*).

B. Pertinent Law

In rejecting claims under 35 U.S.C. § 103, it is incumbent upon the examiner to establish a factual basis to support the legal conclusion of obviousness. See *In re Fine*, 837 F.2d 1071, 1073, 5 USPQ2d 1596, 1598 (Fed. Cir. 1988). In so doing, the examiner is expected to make the factual determinations set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 17, 148 USPQ 459, 467 (1966), and to provide a reason why one having ordinary skill in the pertinent art would have been led to modify the prior art or to combine prior art references to arrive at the claimed invention. Such reason must stem from some teaching, suggestion or implication in the prior art as a whole or knowledge generally available to one having ordinary skill in the art. *Uniroyal, Inc. v. Rudkin-Wiley Corp.*, 837 F.2d 1044, 1051, 5 USPQ2d 1434, 1438 (Fed. Cir. 1988).

As specified in MPEP 2143, a *prima facie* case of obviousness is met when the following three basic criteria are met: (1) there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings, (2) there must be a reasonable expectation of success, and (3), the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, not in applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

The showings by the examiner are an essential part of complying with the burden of presenting a *prima facie* case of obviousness. See *In re Oetiker*, 977 F.2d 1443, 1445, 24 USPQ2d 1443, 1444 (Fed. Cir. 1992). If that burden is met, the burden then shifts to the applicant to overcome the *prima facie* case with argument and/or evidence. Obviousness is then determined on the basis of the evidence as a whole. See id.; In re Hedges, 783 F.2d 1038, 1039, 228 USPQ 685, 686 (Fed. Cir. 1986).

When establishing *prima facie* obviousness of a claimed invention, there must be an explanation as to the reasons one skilled in the art would have been motivated to select the references and to combine them to render the claimed invention obvious. *In re Rouffet* 149 F.3d 1350, 1357-59, 47 USPQ2d 1453, 1455-1457 (Fed. Cir. 1998). It follows that all of the words recited in a claim must be considered in judging the patentability of that claim against the prior art. *In re Wilson*, 424 F.2d 1382, 1385, 165 USPQ 494, 496 (CCPA 1970).

In the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art," a *prima facie* case of obviousness exists. *In re Wertheim*, 541 F.2d 257, 191 USPQ 90 (CCPA 1976). Applicants can rebut a *prima facie* case of obviousness based on overlapping ranges by showing the criticality of the claimed range. *In re Woodruff*, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990). A *prima facie* case of obviousness may also be rebutted by showing that the art, in any material respect, teaches away from the claimed invention. *In re Geisler*, 116 F.3d 1465, 1471, 43 USPQ2d 1362, 1366 (Fed. Cir. 1997).

C. The combination of *Robelet*, *Vander Voort* and *Mitsuo* does not amount to a *prima facie* case of obviousness of claims 1 and 4

Reversal of the rejection of claims 1 and 4 is respectfully requested on the basis that the combination of *Robelet*, *Vander Voort* and *Mitsuo*, fails to render the pending claims *prima facie* obvious. The reasons why the combination of *Robelet*, *Vander Voort* and *Mitsuo* fails to render the pending claims *prima facie* obvious are as follows.

1. The combination of *Robelet*, *Vander Voort* and *Mitsuo* does not teach every constituent content range required by the pending claims.

2. The pending application teaches the criticality of the certain constituent content ranges recited in the claims which are not taught by the combination of *Robelet*, *Vander Voort* and *Mitsuo*.

3. The combination of *Robelet*, *Vander Voort* and *Mitsuo* would not motivate one skilled in the art to make the microalloyed steel having the constituent content ranges required by the pending claims.

In the following discussion, each of the reasons why the combination of *Robelet*, *Vander Voort* and *Mitsuo* fails to teach or suggest the microalloyed steel according to the pending claims will be discussed. The discussion will show that the burden for establishing a case of *prima facie* case of obviousness is not met, and that the current rejection of the claims cannot be sustained.

1. <u>The combination of *Robelet*, *Vander Voort* and *Mitsuo* does not teach every constituent content range required by the pending claims</u>

The combination of *Robelet*, *Vander Voort* and *Mitsuo* does not teach every constituent content range required by the pending claims, whether considered individually or collectively.

At the onset, contrary to the examiner's comments in the advisory action, it is respectfully submitted that the applicants fully understand that one cannot show unobviousness by attacking references individually when a rejection is based on a combination of references. As is well understood, obviousness is determined on the basis of the combination of cited references considered as a whole. However, if each of the individual references fails to teach or suggest a certain limitation of the claims, the combination as a whole cannot be construed to render such limitation obvious.

The applicants will thus show that *Robelet*, *Vander Voort* and *Mitsuo*, whether considered collectively or individually, fail to teach every claimed content range, and the combination of the recited content ranges of the pending claims.

a. Calcium and Oxygen

Pending claims 1 and 4 both require a microalloyed steel formed by a combination of constituents including a content range of 0.001 to 0.01 wt% of oxygen, and a content range of 0.0001 to 0.01 wt% of calcium.

The content ranges of calcium and oxygen are essential to making the claimed microalloyed steel (page 14, lines 3-23). For example, calcium is used to displace part of the manganese in MnS to form a solid solution of calcium in MnS to improve machinability (page 14, lines 3-12). In order to obtain the solid solution of calcium in MnS, the oxide of calcium must be present. So, it follows that it is critical that a certain range of oxygen is provided in order to form the solid solution of calcium in MnS in order to improve machinability (pate 14, lines 13-23).

Contrary to the assertion in the advisory action, *Robelet* does not disclose the content range of calcium in the pending claims, and further does not disclose the use of any content of oxygen in the disclosed steels. About the most that can be said of *Robelet* is that it broadly suggests treating the disclosed steels with calcium (col. 4, lines 18-20). Yet, *Robelet* only refers to the simple notion of treating the disclosed steels and fails to provide any direction to one skilled in the art how to or how much calcium should be used.

Apparently relying on the broad statement by *Robelet*, the advisory action posits that the calcium range of 0.00001 to 0.01 wt% is within the scope of *Robelet*. However, there is no evidence within *Robelet* that supports the content range required by the pending claims. If left only with the teachings of *Robelet*, one skilled in the art would be required to guess how much of a calcium content range would be required. Guessing a content range is not the same as an explicit or implicit teaching of a certain content range that is taken in combination with other content ranges to form a microalloyed steel.

Thus, one skilled in the art of making microalloyed steels would not be motivated by *Robelet* to provide the content range of calcium required by the pending claims.

Vander Voort and *Mitsuo* fail to make up for the shortcomings of *Robelet*, and would not motivate one skilled in the art to know much calcium should be used in a microalloyed steel.

For example, *Vander Voort* does not disclose the use of calcium, or of the claimed content range of oxygen in combination with the content ranges of other required constituents. Instead, *Vander Voort* discusses the use of the claimed contents of oxygen merely in an iron-oxygen alloy, and not in a micro-alloyed steel (page 1, 3rd full paragraph).

Similarly, *Mitsuo* does not disclose the use of any contents of calcium and oxygen in the disclosed steels.

Having made these observations, it is readily apparent that *Robelet*, *Vander Voort* and *Mitsuo*, either individually or collectively, fail to teach or suggest to one skilled in the art the content ranges of calcium and oxygen taken in combination with the other required constituents in the microalloyed steel of the pending claims. Therefore, the combination of *Robelet*, *Vander Voort* and *Mitsuo* fails to teach or suggest every limitation required by the pending claims.

b. Combination of constituents

While *Robelet* very broadly discloses certain content ranges of constituents in a steel, there is no teaching or suggestion of combining the constituents in the required manner of the pending claims (col. 2, lines 29 – 49). Instead, *Robelet* teaches three different working examples each having certain combinations of different amounts of constituents (col. 4, line 41 through col. 5, line 62).

The following table exemplifies the different examples taught by *Robelet* in comparison to the contents required by the pending claims. It will be noted, however, that only the common constituents disclosed by both *Robelet* and the pending claims are identified (leaving out calcium and oxygen).

	C	Si	P	Mn	Cr	Cu	Ni	T_{tr}	C_{eq}
Ex. 1	0.71	0.25	0.045	0.8	0.05	0.3	0.08	0.52	0.96355
Ex. 2	0.505	0.24	0.075	1.3	0.08	0.32	0.11	0.167	0.87105
Ex. 3	0.39	0.75	0.103	1.24	0.15	0.2	0.13	0.645	0.79383
Claims 1 and 4	0.15-0.35	0.5-2.0	0.03-0.15	0.5-1.5	0.01-1.0	0.01-0.5	0.01-0.5	0-1.5	0.6-0.85

As shown in the table, it is clear that *Robelet* does not suggest or teach the required combination of constituents having certain ranges required by the pending claims. For example, the content ranges of carbon and C_{eq} in the alloy of examples 1 and 2 of *Robelet* clearly do not fall within the range required by the pending claims. Concerning example 3, the content of carbon is also outside the range required by the claims, and vanadium (V) is included as a constituent (col. 5, lines 46-63).

In view of the examples shown in the table, *Robelet* seems to suggest to one skilled in the art the formation of an alloy having a carbon content that is distinguished from the amount required by the pending claims. From a technological standpoint, the addition of carbon into an alloy contributes in improving hardness as well as toughness of the alloy. On the other hand, a larger amount of carbon, as required in the examples of *Robelet*, results in a deterioration of machinability thereof due to the rise in hardness. Moreover, an excessive amount of carbon results in an increase of transition temperature, and does not significantly improve fatigue strength.

The C_{eq} in examples 1 and 2 of *Robelet* is clearly outside of the range prescribed by the pending claims, and therefore teaches away from the pending claims. The alloys in examples 1 and 2 yield an alloy having less toughness at room temperature, and low machinability due to a higher C_{eq} (as explained in the pending application on page 15, line 19 through page 16, line 6).

Turning to example 3 of *Robelet*, this example teaches away from the alloy required in the pending claims. Specifically, example 3 includes vanadium to compensate for the separatability due to the low carbon content. Of course, as explained in the pending application, the combination of the constituents and their corresponding content ranges in the alloy of the pending claims preclude the need for vanadium (page 7, lines 11-14). As a result, a microalloyed steel can be produced at a lower cost than those including vanadium.

Of course, the microalloyed steel of the pending claims is designed so that it has (i) toughness at its working temperature, (ii) an excellent separability at low temperature, (iii) enhanced fatigue strength, and (iv) improved machinability. These advantages are accomplished by the relatively low carbon content in combination with the other constituents of the alloy. This combination of low carbon content in combination with the other constituents of the pending claims, however, is neither taught nor suggested by *Robelet*. *Vander Voort* or *Mitsuo* do not make up for the aforementioned shortcomings of *Robelet*.

It is submitted that the combination of *Robelet*, *Vander Voort* and *Mitsuo* would not teach or suggest to one skilled in the art the alloy required by the pending claims having the specific constituents and their content ranges.

2. The pending application teaches the criticality of the specifically required ranges of contents recited in the claims

The constituent content ranges in the microalloyed steel of the pending claims are critical and not arbitrary, and therefore are not *prima facie* obvious. As discussed in section (1), the content ranges of carbon, calcium and oxygen required by the claims are not taught. Because these content ranges are critical, as discussed below, and not specifically taught by the cited references, it is submitted that they are not *prima facie* obvious.

For example, the range of carbon content is established so as to enhance strength and to obtain an optimal impact transition curve (page 8, line 16 through page 9, line 13). A balance is obtained between upper and lower shelf energies. For

the alloy of the pending claims, the upper shelf should be as high as possible, and the impact strength should decrease abruptly to reach the lower shelf energy. For attaining this, the upper range limit of carbon is 0.35 wt% and the lower limit is 0.15 wt% since too low of carbon content yields an alloy having insufficient strength.

The criticality of the content range of carbon required by the pending claims is clearly not taught in *Robelet*, *Vander Voort* or *Mitsuo,* whether considered individually or collectively.

Turning to the calcium content range, a sufficient amount of calcium is required to displace manganese in MnS form to a solid solution of calcium in MnS (page 14, lines 3-12). This improves the machinability. In order to obtain such an effect, calcium should be contained in an amount of 0.0001wt% or higher. On the other hand, the upper limit of calcium is 0.01 wt% since the effect of calcium on MnS does not change significantly when calcium is provided in larger quantities.

The criticality of the content range of calcium required by the pending claims is clearly not taught in *Robelet*, *Vander Voort* or *Mitsuo,* whether considered individually or collectively.

Regarding oxygen, the content range oxygen is provided since oxygen is an element necessary for the formation of calcium oxide which is used in treating MnS (page 13, line 13-22). The lower limit of oxygen is provided so as to have a sufficient amount to form calcium oxide, whereas the upper limit is provided for preventing oxide inclusions which causes cracks in the alloy during hot processing.

While oxygen is an inevitable impurity, there is no teaching of the criticality of the content range of oxygen for forming calcium oxide required by the pending claims in *Robelet*, *Vander Voort* or *Mitsuo*, whether considered individually or collectively.

3. The combination of *Robelet*, *Vander Voort* and *Mitsuo* would not motivate one skilled in the art to make a microalloyed steel having the specific content ranges required by the pending claims

The rejection fails to establish a *prima facie* case of obviousness because none of the cited references provide any suggestion or motivation to combine the references to obtain the claimed microalloyed steel having the required content ranges of carbon, calcium, oxygen and C_{eq}, and in combination with the other constituent content ranges required by the pending claims.

It has been established that there is no suggestion or motivation in *Robelet* to use carbon, calcium, oxygen and C_{eq} in the claimed content ranges, and in combination with the other required constituents and their corresponding content ranges. Moreover, *Robelet* does not discuss at all the use of oxygen in a microalloyed steel, and therefore, can provide no motivation or suggestion to use oxygen in the claimed concentration in a microalloyed steel.

Robelet discloses the optional treatment of steel with calcium, but makes no disclosure as to the amount of calcium used, the criticality of calcium, or even whether the calcium becomes part of the chemical composition of the steel. The rejection, on the other hand merely relies on conjecture as to the range of calcium that would be acceptable for the alloy thereof. Therefore, *Robelet* certainly does not suggest the claimed concentrations of calcium as part of the chemical composition of the claimed microalloyed steel.

There is no motivation or suggestion in *Vander Voort* to use carbon, calcium, oxygen and C_{eq} in microalloyed steels in the content ranges claimed in combination with the content ranges of the other constituents.

Vander Voort provides no discussion regarding the use of calcium in the claimed concentrations in a microalloyed steel, and therefore can proffer no motivation or suggestion to use calcium in the claimed concentrations in a microalloyed steel.

While *Vander Voort* discusses the use of oxygen in iron-oxygen alloys in order to affect the toughness of the alloy (page 1, paragraph 3), there is no discussion as to the criticality of a certain range. Instead, *Vander Voort* discloses that in steels having carbon at a concentration of .003, large variations in oxygen content have no

influence on brittleness (page 2, paragraph 3). *Vander Voort* therefore teaches away from adding oxygen, in the claimed concentrations, as an unnecessary additional element having no effect on the brittleness of a microalloyed steel.

Vander Voort provides no suggestion of providing a certain range of oxygen for forming calcium oxide, as described by the pending application. Of course, it is well known that there will be oxygen impurities of the type acknowledged by the instant application. Yet, there is no evidence in *Vander Voort* which would motivate one skilled in the art, in combination with the teachings of *Robelet*, of the criticality of providing an oxygen content that falls in the range prescribed by the pending claims in order to provide a sufficient amount of oxygen of calcium oxide while preventing excessive oxygen in order avoid oxide includes.

Accordingly, in view of the teachings of the combined teachings of *Robelet* and *Vander Voort*, one of ordinary skill in the art would not be motivated to use oxygen in the content ranges of the pending claims, because *Vander Voort* indicates that there would be no benefit to the addition of the oxygen and fails to discuss the use of oxygen in connection with calcium.

Lastly, *Mitsuo*, which is not relied on in the action for teachings regarding content levels of carbon, calcium, oxygen and C_{eq}, does not discuss at all the use of calcium and oxygen in steel, and therefore cannot provide motivation or suggestion to overcome the shortcomings in the teachings of *Robelet* and *Vander Voort*.

Since the combination of *Robelet*, *Vander Voort* and *Mitsuo* fails to teach or suggest a microalloyed steel having the content ranges of carbon, calcium, oxygen and C_{eq} that are required in the pending claims, a *prima facie* case of obviousness cannot be sustained. Therefore, withdrawal of this rejection is respectfully requested.

VIII. CONCLUSION

For the reasons set forth above, independent claims 1 and 4 of the pending application define subject matter that is not rendered obvious within the meaning of 35 U.S.C. § 103(a) by the proposed combination of *Robelet, Vander Voort* and *Mitsuo*.

Reversal of the rejection of claims 1 and 4 is respectfully requested. Since claims 2, 3 and 5-7 depend from one of claims 1 and 4, the reversal of the rejection of these claims is likewise requested. The Office is authorized to charge any additional fees associated with this communication Deposit Account No. 02-0200.

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Respectfully submitted,

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IX. CLAIMS APPENDIX

Claim 1. A microalloyed steel separable by fracture splitting at low temperatures, which comprises from 0.15 to 0.35 wt% carbon, from 0.5 to 2.0 wt% silicon, from 0.5 to 1.5 wt% manganese, from 0.03 to 0.15 wt% phosphorus, from 0.01 to 0.15 wt% sulfur, from 0.01 to 0.5 wt% copper, from 0.01 to 0.5 wt% nickel, from 0.01 to 1.0 wt% chromium, from 0.001 to 0.01 wt% soluble aluminium, from 0.005 to 0.035 wt% nitrogen, from 0.0001 to 0.01 wt% calcium, and from 0.001 to 0.01 wt% oxygen, the remainder comprising iron and inevitable impurities, and which satisfies the following relationships 1 and 2:

Relationship 1,

$0.6 \leq Ceq \leq 0.85$,

wherein

$Ceq = C+0.07xSi+0.16xMn+0.61xP+0.19xCu+0.17xNi+0.2xCr$;

Relationship 2,

$0 \leq T_{Tr} \leq 1.5$,

wherein $T_{Tr} = (C+0.8xSi+5xP)-0.5x(Mn+Cr+Cu+Ni)$;

wherein the microalloyed steel lacks vanadium.

Claim 2. The microalloyed steel separable by fracture splitting at low temperatures according to claim 1, which contains one or both of up to 0.02 wt% titanium and up to 0.02 wt% zirconium in place of part of the iron as the remainder.

Claim 3. The microalloyed steel separable by fracture splitting at low temperatures according to claim 1 or 2, which contains one or both of up to 0.3 wt% lead and up to 0.3 wt% bismuth in place of part of the iron as the remainder.

Claim 4. A fitting member produced through separation by fracture splitting at a low temperature, which comprises from 0.15 to 0.35 wt% carbon, from 0.5 to 2.0 wt% silicon, from 0.5 to 1.5 wt% manganese, from 0.03 to 0.15 wt% phosphorus, from 0.01 to 0.15 wt% sulfur, from 0.01 to 0.5 wt% copper, from 0.01 to 0.5 wt% nickel, from 0.01 to 1.0 wt% chromium, from 0.001 to 0.01 wt% soluble aluminium, from 0.005 to 0.035 wt% nitrogen, from 0.0001 to 0.01 wt% calcium, and from 0.001 to 0.01 wt% oxygen, the remainder comprising iron and inevitable impurities, and which satisfies the following relationships 1 and 2:

Relationship 1,

$0.6 \leq Ceq \leq 0.85$,

wherein

$Ceq = C+0.07xSi+0.16xMn+0.61xP+0.19xCu+0.17xNi+0.2xCr$;

Relationship 2,

$0 \leq T_{Tr} \leq 1.5$,

wherein $T_{Tr} = (C+0.8xSi+5xP)-0.5x(Mn+Cr+Cu+Ni)$;

wherein the microalloyed steel lacks vanadium.

Claim 5. The fitting member produced through separation by fracture splitting at a low temperature according to claim 4, which contains one or both if of up to 0.02 wt% titanium and up to 0.02 wt% zirconium in place of part of the iron as the remainder.

Claim 6. The fitting member produced by separation by fracture splitting at a low temperature according to claim 4 or claim 5, which contains one or both of up to 0.3 wt% lead and up to 0.3 wt% bismuth in place of part of the iron as the remainder.

Claim 7. The fitting member produced through separation by fracture splitting at a low temperature according to claim 4 or claim 5, which is a connecting rod for an engine.

X. EVIDENCE APPENDIX

There are no copies of evidence entered and relied upon in this appeal of the pending application.

XI. RELATED PROCEEDINGS APPENDIX

There are no related proceedings or decisions rendered by a court or the Board of Appeals in any proceeding identified in the related appeals and interferences section in the pending application.